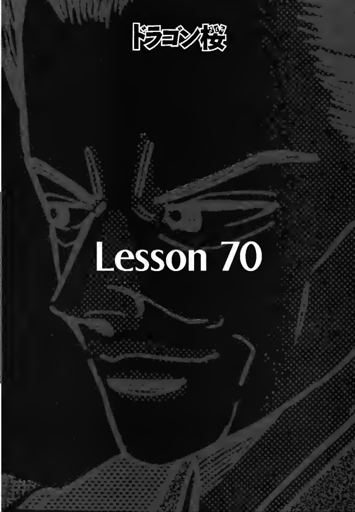
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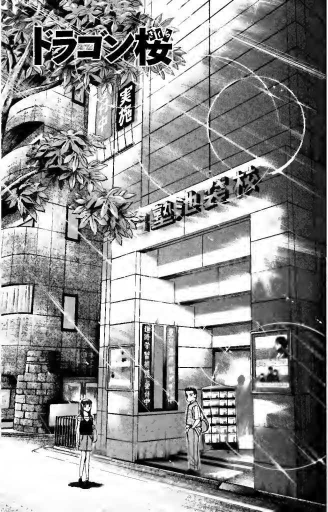
Lesson 70

DAY OF THE MOCK EXAM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B
LONG TIME PLAYER
WOAH... SO MANY PEOPLE.
LOOKS LIKE WE'RE SEATED QUITE FAR APART.


THIS IS MY SEAT.
MINE'S ON THE OPPOSITE END. GOOD LUCK.
PUMA


I WONDER HOW MANY ARE APPLYING FOR TOUDAI...
OH... STOP THINKING.
SENSEI REMINDED US TO NOT THINK ABOUT OTHER PEOPLE.
RIGHT...
I SHOULD TRY THE METHOD THAT WE LEARNT YESTERDAY.


IT LOOKS LIKE MIZUNO IS GOING .. I SHOULD DO THE SAME.
DO YOU REMEMBER WHAT TO DO BEFORE THE EXAM?
WHEN THE CHIEF EXAMINER SAYS START, WE SHOULD NOT LOOK AT THE QUESTIONS IMMEDIATELY. WE SHOULD CLOSE OUR EYES, TAKE A DEEP BREATH AND OBSERVE OUR SURROUNDINGS.
YES...
ONE MORE THING YOU SHOULD DO AFTER ENTERING THE EXAM HALL.
FIRST...


GO TO THE TOILET AND LOOK AT YOUR OWN REFLECTION IN THE MIRROR.
TOILET?
MIRROR?
YES.
EVERYONE FEELS NERVOUS BEFORE AN EXAM.
EVEN MORE SO WHEN WE ARE TOGETHER WITH STRANGERS IN AN UNFAMILIAR LOCATION.

JUST LIKE YOU WILL FIND YOUR OPPONENT UNUSUALLY STRONG WHEN YOU DON'T KNOW HIS ABILITY,
THAT IS DUE TO YOUR IMAGINATION INFLATING THE UNKNOWN FACTORS.
WHICH WILL CAUSE YOU TO BE NERVOUS...
AM I A MATCH FOR THAT GUY? WHAT ARE MY CHANCES OF WINNING?
WE LOSE OURSELVES FROM THE MOMENT WE FEEL ANXIETY.
WE WILL THEN NOT BE ABLE TO SHOW OUR FULL ABILITY.
WHAT SHOULD WE DO TO AVOID THAT?


IT MIGHT SOUND STUPID BUT IT WORKS AMAZINGLY WELL. YOU WILL STEADILY FEEL CALMER.
YOU WILL VIEW YOURSELF OBJECTIVELY.
THAT IS THE REASON YOU REFLECT USING THE MIRROR.
TO LET YOUR CONFIDENT SELF IN THE MIRROR TALK TO YOU.


SAY SOMETHING ENCOURAGING TO YOURSELF. IMAGINE FEELING MOTIVATED.
I CAN DO IT.
I CAN BE AT MY BEST AS LONG AS I DO WHAT I USUALLY DO.

YOU SHOULD ALSO BE CAREFUL OF THINGS THAT MIGHT CAUSE YOU TO LOSE YOUR CONFIDENCE AGAIN.
I SEE. I WILL BE ABLE TO GET BACK MY CONFIDENCE.
YOU SHOULD DO THE SAME AFTER EVERY PAPER.
EH? AGAIN?
YOU WILL STUDY AND REVISE BEFORE THE EXAM TO GAIN SOME CONFIDENCE, RIGHT?
THAT'S RIGHT.
INDEED NOT. THE MOCK EXAM COVERS A WIDE RANGE OF TOPICS. THERE WON'T BE MUCH EFFECT EVEN IF YOU TRY TO DO LAST MINUTE REVISION. IT WILL INSTEAD MAKE YOU NERVOUS.
EH? SHOULD WE NOT DO THAT?


YOU CAN TRY TO PLAY A GAME TO RELAX YOURSELF.
A GAME?
SO JUST PLACE YOUR STATIONERY ON THE TABLE.
LOOK AROUND AT THOSE DOING LAST MINUTE REVISION...
IMAGINE THAT THEY ARE VEGETABLES OR ANIMALS.
HE LOOKS LIKE A RADISH...
OH... THAT GUY LOOKS LIKE A HIPPO...
OH GOD... HE LOOKS SO MUCH LIKE A MONKEY.


WRITE YOUR CHOICE OF SCHOOL ON THE ANSWER SHEET.
TOWDAI MEDICAL SCHOOL
EH... MEDICAL SCHOOL...
SERIOUSLY?


キンコン
カンコン
YOU MAY START NOW.
IIIB・IIIC型
IIIB型, IIIC型受験者は次の表に従って解答すること。
IIIB型 1, 2, 3, 4 を必答し, 5, 6 より1題選択。
IIIC型 1, 2, 3, 4 を必答し, 5, 6, 7 より1題選択。
1 【IIIB IIIC型共通 必須問題】(配点 40点)
(1) θの関数
f(θ)=cos2θ−√3sin2θ−2sinθ+2√3cosθ
(0≦θ≦π) がある。
2 【IIIB・IIIC型共通 必須
a₁ = −18,
aₙ₊₁ = 3aₙ+40n−22 (n=1, 2, 3, …)
The above defines the sequence (aₙ).
(1) Find a₂.
(2) Let bₙ = aₙ₊₁−aₙ for n = 1, 2, 3, . . . Express bₙ₊₁ in terms of bₙ.
(3) Find bₙ, and thus aₙ, explicitly.
(4) Find the value(s) of n such that aₙ is a multiple of 4.


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THE EXAM'S STARTED.
YA...
SORRY THAT ALL OF YOU HAVE TO COME IN ON A SUNDAY.
NO WORRIES. TODAY IS CRUCIAL FOR EVERYONE.


THIS GUY... HE'S RIDICULOUSLY FAST.


HOW'S THE EXAM?
TOTALLY IMPOSSIBLE
IT BLEW ME AWAY LIKE A GRAIN OF SAND.
ME TOO... ESPECIALLY ENGLISH AND SOCIAL STUDIES.
WE'LL BE A LAUGHING STOCK, AIMING FOR TOUDAI.

TL NOTE: GOOGLE SAYS THAT ANYONE TRYING TO ENTER TOUDAI IS AN "ALIEN" DUE TO HOW TOUGH IT IS TO GET IN (1% CHANCE?).


WHY ARE ALL THE TEACHERS HERE?
THIS IS ONE OF THE SCHOOL'S METHODS.
TO STRIKE WHILE THE IRON IS HOT!


SO... HOW WAS THE EXAM?
I DON'T UNDER-STAND...
STRIKE WHILE IRON IS HOT?
IT FELT LIKE I COULDN'T ANSWER A SINGLE QUESTION.
DISAS-TROUS.


OH~ THAT'S GREAT!
YUP.
WE FEEL REASSURED NOW.
EH?
WHY?

QUESTION 2 ON PAGE 15

1 Question

$$\begin{cases} a_1 = -18 \\ a_{n+1} = 3a_n + 40n - 22 \ (n = 1, 2, 3 \dots) \end{cases}$$

The above defines the sequence (a_n).

1. Find a_2.
2. Let $b_n = a_{n+1} - a_n$, for $n = 1, 2, 3 \dots$ Express b_{n+1} in terms of b_n.
3. Find b_n, and thus a_n, explicitly.
4. Find the value(s) of n such that a_n is a multiple of 4.

2 Solution

1. $a_2 = a_{1+1} = 3.a_1 + 40 \cdot 1 - 22 = -3 \cdot 18 + 40 - 22 = -36$
2. We are given $b_n = a_{n+1} - a_n$, so $b_n = 2a_n + 40n - 22$.

   Now $b_{n+1} = 2a_{n+1} + 40(n+1) - 22 = 2(3a_n + 40n - 22) + 40n + 40 - 22 = 6a_n + 80n - 44 + 40n + 40 - 22$. This equals $6a_n + 120n - 26 = 3b_n + 40$.
3. First let us determine $b_1 = a_2 - a_1 = -18$.

   Now for $n > 1$ we have $b_n = 40(1 + 3 + \ldots + 3^{n-2}) - 18 \cdot 3^{n-1}$.

   Recall that as the sum of a geometric progression $(1 + 3 + \ldots + 3^{n-2}) = (3^{n-1} - 1)/(3 - 1)$.

   So we have $b_n = 20(3^{n-1} - 1) - 18 \cdot 3^{n-1} = 2 \cdot 3^{n-1} - 20$.

   Since $b_n = 2a_n + 40n - 22$, we have $a_n = (b_n - 40n + 22)/2 = (2 \cdot 3^{n-1} - 20 - 40n + 22)/2 = 3^{n-1} + 1 - 20n$.

   Check this for $n = 2$: $a_2 = 3 + 1 - 20 \cdot 2 = -36$.
4. We would like $3^{n-1} + 1 - 20n \equiv 0 \mod 4$.

   We may disregard the $20n$ as 20 is already a multiple of 4, so we just need $3^{n-1} + 1 \equiv (-1)^{n-1} + 1 \equiv 0 \mod 4$, which is the case for every even n.

   For every odd n we have a remainder of $1 + 1 = 2 \mod 4$.


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